Title of the Invention D-1569

BUCKLE

Background of the Invention and Related Art Statement

The present invention relates to a buckle including a female member and a male member for detachably connecting string members. More particularly, the present invention relates to a buckle capable of being released from an engaged state with a load, i.e. pulling-out force, larger than a predetermined level, so that an excessive load is not applied to a body part such as a neck and arm. Incidentally, in the specification, a string member includes a belt, band, cord and other similar members.

A buckle includes a female member and a male member, and is used for, for example, putting on and taking off a string member suspending a card case with various cards or a portable device from a neck; putting on and taking off a string member for attaching a small article such as eyeglasses to a head portion; or detachably connecting string members at an opening portion of a cloth. In the applications described above, when a string member connected in a loop shape with the female member and the male member is caught in an object, an excessive load may be directly or indirectly applied to a body part, thereby causing a dangerous situation. Therefore, the female member needs to engage the male member such that the engagement therebetween is not released improperly with a force below a predetermined level, while the engagement is released with a pulling-out force greater than a predetermined level.

Incidentally, in terms of the buckle design, when the female member and the male member receive a predetermined pulling-out force, the female member is released from the male

member through breaking, or through a process same as that of a normal operation of releasing the female member from the male member against the engaging force. Although the former system (breaking) is effective in avoiding danger, the buckle can not be used again. In the latter system, while the buckle can be used again, it is difficult to control a variation in the pulling-out force while maintaining a predetermined engaging force.

Figs. 7(a) and 7(b) show a buckle disclosed in Japanese Utility Model No. 3086720 as an example. The buckle (neck strap) includes a female member 50 and a male member 55 having base portions 51 and 56 attached to end portions 60a of string members 60. The female member 50 has engaging portions 53, and the male member 55 has engaging portions 57. The engaging portions 53 are released from the engaging portions 57 with a pulling-out force greater than a specific level.

In the buckle, from a rear side toward a front side thereof, the female member 50 includes a base portion 51 with an attaching hole 51a, an intermediate portion provided with the engaging portions 53, and a forward end portion 52 defining a frame-like entrance 50a. The end portion 60a of the string member 60 passes through the attaching hole 51a, and is attached to the base portion 51. The engaging portions 53 are formed in concave-shape openings communicating to both outer sides from an inside of the female member 50.

The male member 55 includes the base portion 56 provided with an attaching hole 56a on a rear side and a pair of the engaging portions 57 projecting from the base portion 56. The engaging portions 57 are formed on forward end sides of elastic leg portions 57a with narrow widths projecting from the base

portion 56. As shown in Fig. 7(b), the engaging portion 57 includes an engaging side inclined surface portion 57b gradually increasing a projection height outwardly from the leg portion 57a, and a guiding side inclined surface portion 57c gradually decreasing a projecting height from a peak of the inclined surface portion 57b.

In the structure described above, when the engaging portions 57 are inserted into the female member 50 through the entrance 50a, the leg portions 57a deform so that a space between the engaging portions 57 decreases. When the engaging portions 57 reach the openings of the engaging portions 53, the engaging portions 57 are restored to the original shape to engage the openings at lower portions of the inclined portions 57b. The engaging force is in proportion to the projecting height of each engaging portion 57 with respect to the opening of the engaging portion 53, and depends on a degree of elastic deformation of the leg portion 57a.

In the buckle described above, the engaging portions 57 are formed in symmetrical shapes corresponding to the openings of the engaging portions 53. Further, the inclined surface portion 57b has an angle or an inclination θ with respect to the leg portion 57a, so that the engagement is released with a pulling-out force greater than a specific level. However, in the above-described structure, the pulling-out force for releasing the engagement varies greatly depending on an ambient temperature (for example, at the room temperatures of 30°C and -10°C), or a speed and a direction of pulling the string member 60 attached to the male member 55 while the female member 50 is fixed. Moreover, when the engagement and disengagement are repeated,

the pulling-out force for disengagement is lowered relatively quickly.

In view of the above problems, it is an object of the invention to provide a buckle capable of being released with a constant pulling-out force with a small fluctuation while keeping productivity and a simple structure, thereby improving a commercial value of the buckle.

Further objects and advantages of the invention will be apparent from the following description of the invention.

Summary of the Invention

In order to attain the above objects, according to a first aspect of the invention, a buckle includes a female member and a male member. The female member and the male member include attaching portions to be attached to end portions of string members. The female member and the male member also include an engaging portion and a portion to be engaged. The engaging portion engages the portion to be engaged when they approach to each other, and is disengaged from the portion to be engaged when the engaging portion is pulled away from the portion to be engaged with a force greater than a specific level. One of the female member and the male member is formed of a resin material having hardness lower than that of the other.

According to a second aspect of the invention, a buckle includes a female member and a male member. The female member and the male member include attaching portions to be attached to end portions of string members. The female member and the male member also include an engaging portion and a portion to be engaged. The engaging portion engages the portion to be engaged when they approach to each other, and is disengaged from the

portion to be engaged when the engaging portion is pulled away from the portion to be engaged with a force greater than a specific level. One of a corresponding portion including the portion to be engaged and a corresponding portion including the engaging portion is formed of a resin having hardness lower than that of the other.

In the present invention, the female member and the male member are molded resin products. The male member is inserted into the female member to connect to each other in use, and the engagement is released with a load (pulling-out force) greater than a specific level in a separating direction to elastically release the engagement similar to a conventional buckle. As described as the objects of the invention, it is possible to reduce a variation in a level of the pulling-out force for releasing the engagement. In other words, the pulling-out force is not varied according to an individual product, temperature change or direction of the pulling-out load. Therefore, it is possible to prevent a direct or indirect excessive load applied to a body part and a dangerous situation due to the load when the string member is caught with an article in use.

In an engagement structure of a conventional buckle, it is difficult to reduce the variation of the pulling-out force simply through modifying shapes of the engaging portion and the portion to be engaged. In the present invention, the buckle includes the female member and the male member wherein the female member and the male member are engaged when they approach to each other, while the engagement is released when they are pulled in a separating direction. One of the female member and the male member is made of a resin material having hardness lower than that of the other. Alternatively, one of a

corresponding portion including the engaging portion and a corresponding portion including the portion to be engaged is formed of a resin portion having hardness lower than that of the other.

Accordingly, when a load is applied in a separating direction, the soft resin material or the soft resin portion is exclusively deformed to thereby release the engagement. In the conventional product, the pulling-out force is greatly fluctuated according to a temperature change and the like, so that the product is easy to break. On the other hand, in the present invention, the soft material and the soft material portion can maintain an elastic characteristic or bending property even at a low temperature as compared with the hard material and hard material portion, thereby effectively solving the problems described above.

According to a third aspect of the invention, the female member and the male member have specific simplified shapes, so that molds thereof are simplified. Further, the portion to be engaged of the female member uses a part of a slit partitioning an engagement releasing operation portion, and the engaging portion of the male member is formed at an insertion portion to be inserted into the female member, so that both of them are easily deformed elastically, thereby preventing breakage such as a crack due to an excessive load upon engagement and disengagement.

According to a fourth aspect of the invention, a long groove and a guiding projection are provided for restricting a movement in a width direction within the female member when the insertion portion of the male member is inserted into or

extracted from the female member, so that the fluctuation of the pulling-out force in the pulling-out direction can be reduced.

According to a fifth aspect of the invention, the soft resin material and the soft resin portion are formed of a selected thermoplastic elastomer. The thermoplastic elastomer (TPE) has rubber elasticity at a room temperature and is softened at a high temperature. The TPE includes polyolefin type (TPO), urethane type (TPU), polyester type (TPEE), polyamide type (TPAE), ionomer (IO), and the like. The TPE is more expensive than a hard plastic such as polyacetal (POM), polyamide (PA), polycarbonate (PC) and the like used for a buckle material as a linear member and an engineering plastic. In the fifth aspect of the invention, it is preferable that the TPE is used for only one of the female member and male member or only one of the corresponding portion including the engaging portion and the corresponding portion including the portion to be engaged, so that the engaging force and pulling-out force are balanced while reducing the production cost.

Brief Description of the Drawings

Fig. 1 is a perspective view showing a female member and a male member of a buckle according to the present invention;

Figs. 2(a) and 2(b) are views showing the buckle in a test that a pulling-out force for releasing an engagement between the female member and the male member is determined, wherein Fig. 2(a) is a plan view thereof, and Fig. 2(b) is a sectional view thereof;

Figs. 3(a) to 3(d) are views showing the female member of the buckle, wherein Fig. 3(a) is a plan view thereof, Fig. 3(b) is a bottom view thereof, Fig. 3(c) is a side sectional view

thereof; and Fig. 3(d) is a sectional view taken along line 3(d)-3(d) in Fig. 3(c);

Figs. 4(a) to 4(d) are views showing the male member of the buckle, wherein Fig. 4(a) is a plan view thereof, Fig. 4(b) is a side view thereof viewed from a direction 4(b) in Fig. 4(a), Fig. 4(c) is a bottom view thereof, and Fig. 4(d) is a sectional view taken along line 4(d)-4(d) in Fig. 4(a);

Figs. 5(a) and 5(b) are views showing a modified example of the female member, wherein Fig. 5(a) is a plan view thereof, and Fig. 5(b) is a sectional view thereof;

Figs. 6(a) and 6(b) are views showing a modified example of the male member, wherein Fig. 6(a) is a plan view thereof, and Fig. 6(b) is a sectional view thereof; and

Figs. 7(a) and 7(b) are views showing a conventional buckle, wherein Fig. 7(a) is a perspective view thereof, and Fig. 7(b) is a plan view thereof.

Detailed Description of Preferred Embodiments

Hereunder, embodiments of the invention will be explained with reference to the accompanying drawings. Fig. 1 is a perspective view showing a male member and a female member of a buckle. Figs. 2(a) and 2(b) are views showing the buckle in use, wherein Fig. 2(a) is a plan view thereof, and Fig. 2(b) is a middle sectional view thereof. Figs. 3(a) to 3(d) are views showing the female member of the buckle, wherein Fig. 3(a) is a plan view thereof, Fig. 3(b) is a bottom view thereof, Fig. 3(c) is a middle sectional view thereof, and Fig. 3(d) is a sectional view taken along line 3(d)-3(d) in Fig. 3(c). Figs. 4(a) to 4(d) are views showing the male member of the buckle, wherein Fig. 4(a) is a plan view thereof, Fig. 4(b) is a side view

thereof viewed from a direction 4(b) in Fig. 4(a), Fig. 4(c) is a bottom view thereof, and Fig. 4(d) is a sectional view taken along line 4(d)-4(d) in Fig. 4(a). Figs. 5(a) and 5(b) are views showing a modified example of the female member, wherein Fig. 5(a) is a plan view thereof corresponding to Fig. 3(a), and Fig. 5(b) is a sectional view thereof corresponding to Fig. 3(c). Figs. 6(a) and 6(b) are views showing a modified example of the male member, wherein Fig. 6(a) is a plan view thereof corresponding to Fig. 4(a), and Fig. 6(b) is a sectional view thereof corresponding to Fig. 4(b).

A buckle is designed as a personal item for, for example, putting on and taking off a string member for hanging a card case from a neck portion; putting on and taking off a string member for fixing a small article to a head portion; or tying together or loosening up string members attached to an opening portion of a cloth. The buckle is formed of a female member 1 and a male member 2 with a real size smaller than those shown in the drawings.

The buckle of the invention has features similar to those of a conventional buckle. That is, the female member 1 and the male member 2 include a portion to be engaged and an engaging portion, respectively. When the female member 1 and the male member 2 come close to each other, the female member 1 and the male member 2 engage. When the female member 1 and the male member 2 are pulled in a separating direction, the engagement is released. Also, the female member 1 and the male member 2 are formed of molded resin products.

The buckle of the invention has features different from those of the conventional buckle. That is, one of the female member 1 and the male member 2 is made of a hard resin such as

polyacetal as in the conventional buckle. The other of the female member 1 and the male member 2 is made of a soft resin material having hardness lower than that of the hard resin. The female member 1 and the male member 2 are formed in specific shapes. The female member 1 is made of the hard resin material and the male member 2 is made of the soft resin material, or the female member 1 is made of the soft resin material and the male member 2 is made of the hard resin material. The hard resin material is the same as that of the conventional buckle, and it is preferable that the soft resin material is a thermoplastic elastomer.

As shown in Figs. 1 through 3(d), the female member 1 has a substantially flat cylindrical shape communicating in a front to rear direction, and an inner space is formed with an upper wall 10a, a lower wall 10b and sidewalls 10c. A slit 11 with a substantially U-shape is provided in the upper wall 10a and extends at both sides and a front side. The slit 11 forms an engagement releasing operation portion 12, and a U-shape intermediate slit portion 11a with a concave shape is provided at the front side as a portion to be engaged. The operation portion 12 includes a thin wall hinge portion 14 under a groove portion 13 with a concave section provided between both ends of the U-shape, so that the operation portion 12 is elastically bend around the hinge portion 14 in a vertical direction.

A front side portion 12b of an upper surface of the operation portion 12 projects upward higher than a portion 12a between the groove portion 13 and an approximately intermediate portion in the front and rear direction, so that it is easy to disengage the buckle using the front side portion 12b. Incidentally, an inclined guiding surface 15 slightly expanding

an opening height toward the outer side is formed on an inner entrance side of the upper wall 10a. A lower wall 10b is provided with a rear side attaching hole 16 and a guiding projection 17 at a position on a slightly front side than an intermediate portion in the front to rear direction and at an intermediate position in the left to right direction. The attaching hole 16 partitions a rear side portion 16a of the lower wall 10b. Incidentally, reference numeral 18 represents concave portions provided at both sides of the lower wall 10b. The sidewalls 10c have small cut portions on the entrance side to form concave portions 19 depressed toward the rear side viewed from the entrance side.

As shown in Figs. 1 and 4(a)-4(d), the male member 2 has a size corresponding to the female 1, and includes an attaching portion 20 for attaching a string member 3, an inserting base portion 21 and an insertion portion 22 to be inserted into the female member 1 from the rear side to the front side. The attaching portion 20 is provided with an attaching hole 24 passing therethrough vertically. The attaching portion 20 is formed in a frame shape with the attaching hole 24 and a rear side portion 20a. A stopping portion 23 projecting upwardly is formed between the attaching portion 20 and the inserting base portion 21. The stopping portion 23 has a shape corresponding to an end surface of the upper wall 10a at an insertion side thereof in the female member 1, so that the male member 2 is inserted into the female member 2 by a specific distance.

The inserting base portion 21 has a width substantially same as that of the female member 1 at the entrance side. When the male member 2 is inserted into the inner space of the female member 1 from a side of the insertion portion 22, the inserting

base portion 21 fits the concave portions 19 on both sides of the female member 1. The insertion portion 22 includes a long groove 25 disposed at an intermediate portion in the width direction and extending from the front end to substantially an intermediate position in the front to rear direction; a substantially U-shaped slit 26 passing through vertically; an elastically engaging portion 27 partitioned by the slit 26; and small projections 29 disposed on the upper surface at both sides.

The long groove 25 corresponds to the guiding projection 17, and has a width slightly larger than that of the guiding projection 17. The slit 26 is disposed at both sides of the insertion portion and adjacent to the inserting base portion 21 for partitioning the engaging portion 27. The engaging portion 27 has a slightly thin thickness at a lower surface 28 thereof, and is vertically bendable around portions 27c positioned between both ends of the slit 26 due to the long groove 25 and the slit 26 (refer to Fig. 4(c)).

The engaging portion 27 is provided with a convex shape engaging claw 27a for engaging the intermediate slit portion 11a as the portion to be engaged. As shown in Fig. 4(d), the engaging claw 27a of the elastic engaging portion 27 is formed on a summit of the inclining portion 27b gradually extending upward toward the intermediate slit portion of the slit 26 from the front side (with a width slightly smaller than that of the intermediate slit portion). The small projections 29 are provided for easy sliding, reinforcement, and preventing vertical wobbling, and may be omitted.

Figs. 5(a), 5(b) and 6(a), 6(b) are views showing a modified embodiment, wherein the female member 1 and the male member 2 have portions formed of a soft resin (dotted portions)

with a two material molding. As shown in Figs. 5(a) and 5(b), as compared with the female member 1 shown in Figs. 3(a)-3(d), the upper wall 10a has a portion made of a soft resin, for example, a thermoplastic elastomer (hereinafter referred to as TPE) at the engagement releasing operation portion 12 including the thin-walled hinge portion 14 and the front side portion 10d from the intermediate slit portion 11a of the slit 11, i.e. the corresponding portion including the intermediate slit portion 11a as the portion to be engaged. The other portion of the female member is made of a hard resin, i.e. polyacetal (hereinafter referred to as POM).

As shown in Figs. 6(a) and 6(b), as compared with the male member 2 shown in Figs. 4(a) and 4(b), the elastic engaging portion 27 partitioned by the slit 26 and a portion of the engaging portion 27 up to the rear end are formed of the soft resin (TPE), and the other portion of the male member is made of the hard resin (POM).

The female member 1 shown in Figs. 5(a) and 5(b) is used in combination with, for example, the male member 2 entirely made of the hard resin (POM and the like). The male member 2 as shown in Figs. 6(a) and 6(b) is used in combination with, for example, the female member 1 entirely made of the hard resin (POM and the like). Accordingly, it is possible to reduce a manufacturing cost since the hard resin material (POM and the like) is less expensive than the soft resin material (TPE and the like). If both the female member 1 and male member 2, or both the corresponding portions including the engaging portion 27 and the intermediate slit portion 11a are made of the soft resin material (TPE and the like), it is difficult to maintain

the engaging force at a predetermined level and maintain the pulling-out force at a lower value.

The female member 1 and the male member 2 as described above are attached to the corresponding portions 3a, 3b of the string members 3. That is, similar to Fig. 2(b), the corresponding end portion 3a of the string member 3 is inserted into the rear opening of the female member 1 and folded back through the attaching hole 16, so that the rear side portion 16a is sandwiched between a corresponding portion of the string member 3 and the end portion 3a. The sandwiched portion between the corresponding portion of the string member 3 and the end portion 3a is sewed or welded to fix. The end portion 3b of the string member 3 is inserted into the attaching hole 24 of the male member 2 from above and folded back, so that the rear side portion 20a is sandwiched between the corresponding portion of the string member 3 and the end portion 3b. The sandwiched portion between the corresponding portion of the string member 3 and the end portion 3b is sewed or welded to fix.

As a using mode of the buckle, for example, the female member 1 and the male member 2 are attached to both end portions 3a, 3b of a single string member 3 to suspend a portable device from a body part such as a neck. Alternatively, the female member 1 and the male member 2 are attached to free ends 3a of two string members 3, so that the string members 3 open or close an opening portion of a cloth. The present invention is applicable to either mode.

Figs. 2(a) and 2(b) are views showing a state that the buckle described above is in use. In the using state, the summit end of the engaging portion 27, i.e. the engaging claw 27a, is inserted into the intermediate slit portion 11a, i.e.

the portion to be engaged, so that the female member 1 and the male member 2 are connected with the engaging force. In the connected state, the inserting base portion 21 is fitted into the concave portion 19, the guiding projection 17 is positioned in the long groove 25, and the stopper portion 23 abuts against the end surface of the upper wall 10a at the inserting side. Accordingly, it is possible to eliminate wobbling between the male and female members and obtain a feeling that the female member 1 and the male member 2 are integrated.

The female member 1 is disengaged from the male member 2 by pressing the operating portion 12 downwardly. Also, the female member 1 is disengaged from the male member 2 by applying a load to the female member 1 and the male member 2 in the separating direction through both or one of the string members 30. The load for releasing the engagement is defined as a pulling-off force.

In the structure described above, it is possible to maintain the pulling-off force above a specific level, i.e. at a constant level as much as possible without a large fluctuation based on the following features.

First, in terms of the shapes of the members, when the engagement is released with the load in the separating direction, the engaging claw 27a receives a stress from the corresponding inner end surface partitioning the intermediate slit portion 11a, and the engaging portion 27 bends downwardly by the stress around the portion 27c from the engaged state shown in Fig. 2(b). According to the downward bending of the engaging portion 27, the engaging claw 27a is released from the intermediate slit portion 11a, and the male member 2 slides out of the interior of

the female member 1 while pressing the inner surface of the upper wall 1a of the female member.

In a regular operation of releasing the engagement, when the operating portion 12 is pressed downwardly, the engaging portion 27 bends downwardly around the portion 27c in the same manner as described above, and the engaging claw 27a is disengaged from the intermediate slit portion 11a.

Second, in terms of the engagement structure, the pulling-off force for releasing the engagement is almost the same between cases where the load in the separating direction is applied relatively slowly and applied instantaneously excessively, thereby eliminating the fluctuation in the pulling-off force as compared with the conventional buckle. Further, as described later, it is possible to reduce the fluctuation in the pulling-off force according to a use temperature or a direction of the pulling-out force as compared with the conventional buckle. This effect may be attributed to a combination of the following features of the engagement structure. The intermediate slit portion 11a as the portion to be engaged engages the engaging claw 27a of the engaging portion 27 at the intermediate portions of the female member 1 and the male member 2 in the front and rear direction. The engaging claw 27a extends in the width direction, and is disengaged from the intermediate slit portion 11a through the vertical elastic deformation of the engaging portion 27. The slit width of the intermediate slit portion 11a is slightly changed through the elastic deformation of the operating portion 12. The male member 2 is centered through fitting between the long groove 25 positioned at the intermediate portion of the engaging portion 27 and the guiding projection 17 on the female member side.

Third, in terms of a material, the buckle is formed according to the following embodiments. In the following embodiments, an effect of the material of the buckle on the pulling-out force was determined. As a comparison product, the female member 1 and the male member 2 were made of polyacetal (POM). As an embodiment product, the female member 1 was made of POM and the male member 2 was made of a thermoplastic elastomer (TPE). In other words, the same mold was used, and only the materials were changed. As POM, a trade name "DELIN 500P" (hardness D is 80) produced by TORAY DUPONT was used. As TPE, a trade name "HYTREL 5557M" (hardness D is 55) produced by TORAY DUPONT was used. A number of the female members 1 and a number of the male members 2 were produced with the same mold and the different materials.

The pulling-out force for releasing the engagement between the female member 1 and the male member 2 was determined with the following test method. A measured value was an average of ten buckles. In the test, as shown in Fig. 2(b), a fixing member 5 held the string member 3 attached to the female member 1, and the string member 3 attached to the male member 2 was pulled in an arrow direction in Fig. 2(b) at a speed of 100 mm/min to measure the pulling-out force (N). The measurement was conducted after the respective buckles were conditioned at a room temperature for one hour.

In the first test, the female member and the male member were repeatedly engaged and disengaged (by forcibly pulling the string member 30 in the separating direction) hundred times at a room temperature of 20°C. The pulling-out forces (N) for releasing the engagement were compared between the comparison product and the embodiment product. In the test, the fixing

member 5 held the string member 3 at the female member 1, and a load was applied to the string member 3 at the male member 1 in a straight direction to measure the pulling-out force. It was found that while the comparison product showed an average of 136.1 N, the embodiment product showed an average of 22.2 N. Also, the comparison product showed the maximum value of about 139 N and the minimum value of about 82 N, while the embodiment product showed the maximum value of about 29.3 N and the minimum value of about 20.4 N. From the result, it was demonstrated that the embodiment product showed the pulling-out force smaller than that of the comparison product, and the pulling-out force was stable during the hundred times repetition with little variation.

In the second test, the pulling-out forces (N) were compared when the comparison product and the embodiment product were tested at temperatures of 25°C and -10°C (10 degrees below zero). The measuring method was the same as that in the first test. Under the environment of 25°C, the comparison product showed an average of 136.8 N, while the embodiment product showed an average of 22.7 N. Also, the comparison product showed the maximum value of about 139 N and the minimum value of about 86 N, while the embodiment product showed the maximum value of about 29.3 N and the minimum value of about 20.9 N. Under the environment of -10°C, all of the embodiment products were normally engaged and disengaged, while two out of ten comparison products were damaged at the engaging portion of the male member and could not be tested (eight of the comparison products were tested). The comparison product showed an average of 146 N, and the embodiment product showed an average of 25.8 N. Also, the comparison product showed the maximum value of about

156 N and the minimum value of about 143 N, while the embodiment product showed the maximum value of about 28.0 N and the minimum value of about 23.0 N. From the result, it was demonstrated that the embodiment product showed the pulling-out force smaller than that of the comparison product, and the pulling-out force had small fluctuation even in a large temperature change.

In the third test, as shown in Fig. 2(a), the fixing member 5 held the string member 3 at the female member 1, and a load was applied to the string member 3 at the male member 2 in a separating direction with an angle (θ = 15°) to measure the pulling-out force at a temperature of 25°C. The comparison product showed an average of 148 N, and the embodiment product showed an average of 25 N. Also, the comparison product showed the maximum value of about 156 N and the minimum value of about 92 N, while the embodiment product showed the maximum value of about 31 N and the minimum value of about 21 N. From the result, it was demonstrated that the embodiment product showed the pulling-out force smaller than that of the comparison product, and the pulling-out force had small fluctuation due the pulling-out angle (15°).

Incidentally, when the first to third tests were conducted using the female member 1 made of POM and the male member 2 shown in Figs. 6(a) and 6(b) (i.e. engaging portion 27 and the portion of the engaging portion 27 made of TPE and other portion made of POM), substantially the same results were obtained.

As described above, according to the invention, the buckle is formed of the female member and the male member. When the female member and the male member approach each other, they are engaged. When the female member and the male member are pulled in a separating direction, they are disengaged. With the

engaging structure shown in the embodiments, it is possible to reduce the fluctuation in the pulling-out force for disengaging the male member from the female member due to a variation in a product, a temperature, a pulling-out angle, and the like. Accordingly, the buckle of the invention is excellent in safety for a personal item and has a high commercial value.

While the invention has been explained with reference to the specific embodiments of the invention, the explanation is illustrative and the invention is limited only by the appended claims.